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Visual Quality of Human-made Clearings In Central Michigan Conifers

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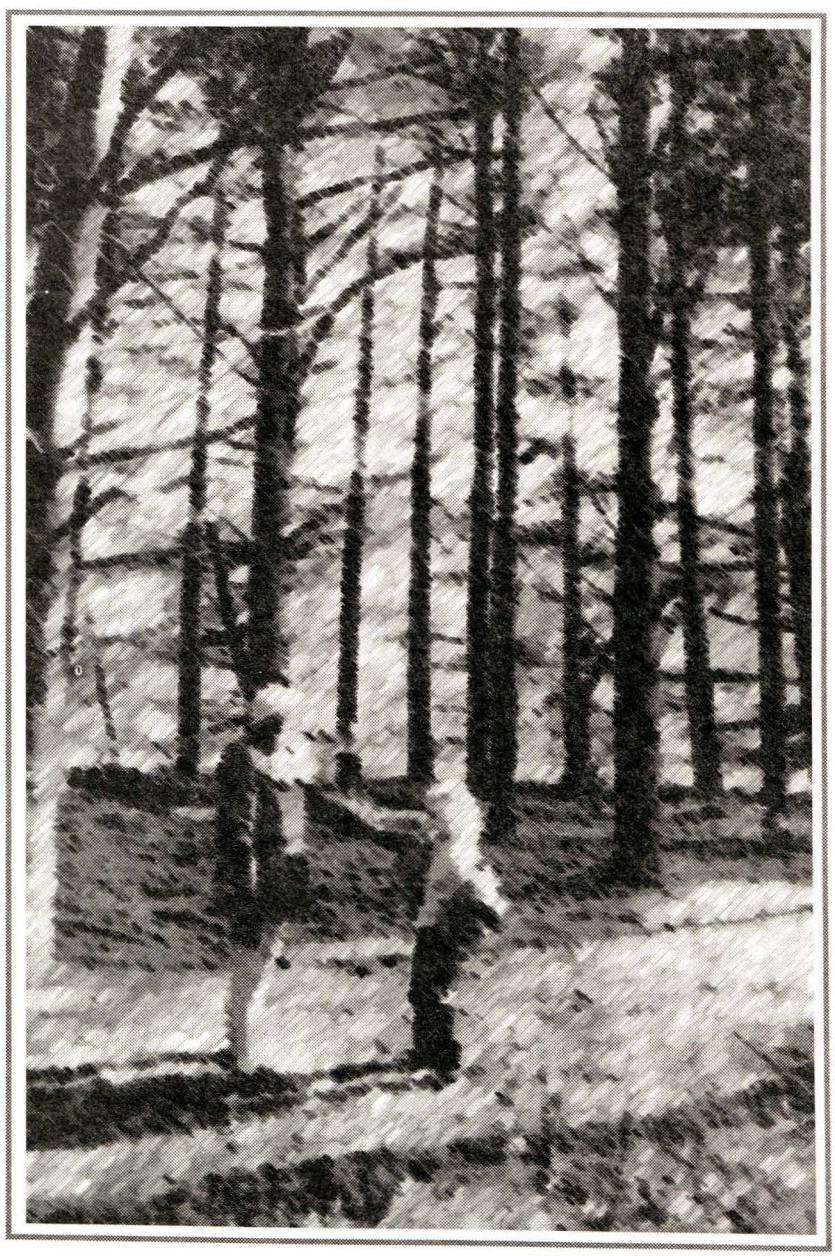

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Assesses and compares visual preferences for human-made forest openings that differ with respect to the size of the opening, the presence or absence of slash, and the length of time since harvest.

KEY WORDS: Landscape, perception, scenic beauty, clearcut.

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Visual Quality of Human-made Clearings In Central Michigan Conifers

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Forest stands are managed for a variety of purposes, including timber, watershed, wildlife, recreation, and visual quality. Effective management requires an understanding of how alternative management schemes affect the ability of the forest to accommodate each of these uses. The effects of timber management practices on forest visual quality have been assessed using quantitative ratings by public groups (Daniel and Boster 1976). These ratings have also been used to develop statistical models for predicting the visual quality of forest landscapes from measurable physical features such as tree density, tree size, and slash volumes (Schroeder and Daniel 1981, Brown and Daniel 1984, Vodak *et al.* 1985). Such models can also be used to show how perceptions of visual quality differ between different groups of viewers (Schroeder 1987).

Much of this research has been carried out in pine stands in the Southwestern and Southeastern United States. The same basic approach can be applied to forest landscapes in other regions, but differences in tree species, age distributions within stands, terrain, management practices, and other site characteristics may prevent the direct transfer of previous results to new forest types. This study applies a perception-based visual quality assessment procedure to conifer forests in central Michigan. In addition to providing information to guide the management of forest landscapes in this region, this research also extends research on visual preferences to a forest type that is distinctly different from any that have so far been investigated.

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The conifer forests of concern in this study are mostly even-age stands of red pine and jack pine that were planted on flat or gently rolling terrain by Civilian Conservation Corps workers in the 1930's. Timber harvests now occurring in these uniform stands are an important source of change in the visual landscape. It is therefore important to understand how alternative approaches to timber harvesting will be perceived by visitors to the forest. We conducted a study to assess and compare visual preferences for human-made forest openings that differ in three factors: (1) size of the opening, (2) presence or absence of slash, and (3) length of time since harvest. The study also investigated whether visual preferences of members of the general public visiting the National Forest differ from those of professional managers and researchers who work for the USDA Forest Service.

METHODS AND ANALYSES

Harvest Method

Ten small experimental clearcuts were made in predominantly red pine stands on the Tawas Ranger District of the Huron National Forest in the spring of 1988. Two cuts were made at each of five sizes: 1, 4, 7, 10, and 15 acres. Slash was completely removed from one clearing of each size. On the other clearing, slash was lopped to 12-24 inches and left on the ground. The clearings were triangular, with one of the corners located at an opening through which the clearcut could be viewed from the road. The clearings were located along both sides of a 1-mile, straight stretch of road. The order of the clearings along the road was random.

The landscape assessment methods used in this study were adapted from the Scenic Beauty Estimation method of Daniel and Boster (1976). In this approach, photographs of forest landscapes are shown to groups of people, who rate them on a numerical scale of scenic beauty.

Daniel and Boster submitted their ratings to a mathematical transformation based on signal detection theory to correct for differences in the raters' standards of judgment and their use of the rating scale. Subsequent research has shown that analyses based on this transformation do not differ appreciably from analyses based on untransformed ratings (Schroeder 1984). Therefore the analyses in this study were performed on raw (untransformed) ratings.

Visual Quality Evaluation: 1988

Method

Photographs of each clearcut were taken shortly after the harvest, in June 1988. All photos were taken by the same photographer, from the center of the road using color slide film and a 28mm lens. The photographs were taken under a uniformly overcast sky. Two sets of color prints (8 x 10 inches) were made from the slides and were mounted in photo albums.

Ninety visitors at campgrounds and at the Lumbermen's Monument visitor center near the study site rated each of the 10 clearcuts in the photo books on a scale of visual quality ranging from 1 (least attractive) to 10 (most attractive). Visitors were told that the photos showed forest openings that had resulted from timber harvesting. The word "clearcut" did not appear in the instructions. Visitors' ratings were obtained during the summer and early fall of 1988. Visitors in Forest Service campgrounds were approached at their campsites by a Forest Service employee, who explained the purpose of the study and invited them to rate the photographs. Visitors to the Lumbermen's Monument were invited by Forest Service staff to participate in the study after they had entered the visitor center building.

Visual quality of the clearcuts was also rated onsite by a group of 30 Forest Service managers and researchers during a technical exchange visit between the Huron-Manistee National Forests and the North Central Forest Experiment Station in the summer of 1988. This group visited the experimental sites as part of a bus tour of field research sites. They had not seen any photographs of the sites before their onsite visit. Members of the group were instructed to rate the scenic quality of the openings as viewed from the center of the road.

Analysis

An analysis of variance (ANOVA) of the viewers' ratings showed that presence or absence of slash and the size of the clearings both had significant effects on perceived visual quality (table 1). Figure 1 shows the effect of size and slash on scenic quality ratings, averaged over all the viewers who rated the clearcuts in 1988. Overall, intermediate-sized clearcuts (4-10 acres) were preferred more than the smallest or the largest clearcuts. Slash had a negative effect on preference ratings, but there was a significant interaction between slash and size, indicating that the magnitude of the effect of slash was different for differently sized clearcuts. The presence of slash had a relatively large impact on the visual quality of the 7- and 15-acre plots and a relatively small impact on the 1- and 10-acre plots (fig. 1).

Table 1.—*ANOVA of ratings made in 1988 of newly harvested clearcuts*

Source	Degrees of freedom	F	P
Slash	1/117	22.312	0.000 *
Size	4/468	10.857	.000 *
Slash X Size	4/468	3.962	.004 *
Rater group	1/117	16.465	.000 *
Slash X Group	1/117	11.327	.001 *
Size X Group	4/468	9.696	.000 *
Slash X Size X Group	4/468	.165	.956

* $p < 0.05$

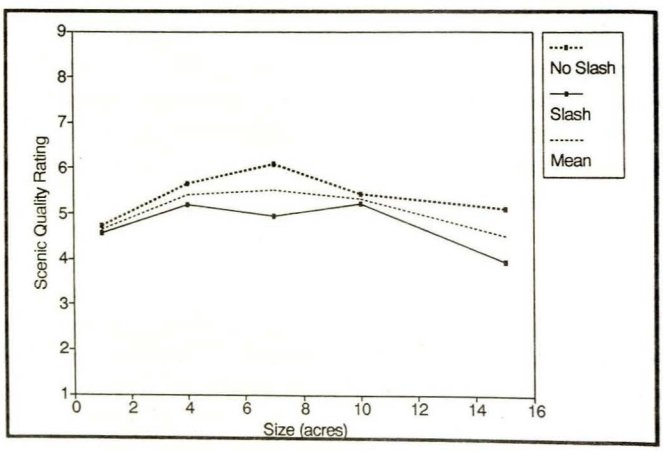

Figure 1.—*1988 ratings of newly harvested clearcuts.*

The ANOVA in table 1 also shows that the two rater groups (visitors and Forest Service employees) differed in their evaluations of the clearcuts. Figure 2 shows that the Forest Service group onsite rated the clearcuts higher on average than did forest visitors viewing photos of the clearcuts. Also, the Forest Service employees onsite were much more sensitive to slash than the public viewing prints, and the Forest Service group tended to like larger openings than the public did. The highest rated size of clearcut for the Forest Service group was 10 acres, while the public preferred the 4- and 7-acre cuts the most. Table 1 shows that all of these group differences are statistically significant.

From these data it is impossible to know whether the differences between the groups occurred because one group saw the clearcuts onsite while the other saw them in prints, or because one group consisted of Forest Service employees while the other consisted of members of the public, or some combination of these two factors. Two years after the harvest, in 1990, additional data were collected to help discriminate between these two factors.

Visual Quality Evaluation: 1990

Method

Two years after the harvest, in June 1990, the 10 clearings were photographed again, by the same photographer and from the same locations as the original photos. The photos were taken at the same time of day, but the lighting conditions differed from the original photos, in that the sky was mostly clear with a few scattered clouds. Grass and other ground cover had recovered substantially since the harvest, and clumps of shrubs had begun growing in the clearcuts.

Eight-by-ten-inch color prints of both the original (1988) and the new (1990) photographs were combined in random order in a photo album. Initial analysis of the 1988 ratings had suggested that foreground features not actually part of the clearcut might influence people's ratings. Therefore, all photos were cropped to minimize the immediate foreground and restrict attention to the clearcut itself. Twenty-six recreationists visiting the Huron National Forest rated each of the 20 photos on a scale of visual quality ranging from 1 (least attractive) to 10 (most attractive). The same photoprints were also rated by a group of 12 Forest Service professional employees. Visual quality of the clearcuts was rated onsite by a group of 17 members of the general public and by a group of 12 Forest Service employees.

Analysis

Figure 3 shows the effects of size, slash, and time since harvest on scenic quality ratings, averaged over all the groups that saw the photoprints of clearcuts in 1990. In an analysis of variance (table 2), the main effects for slash, size, and time since harvest were all significant beyond the

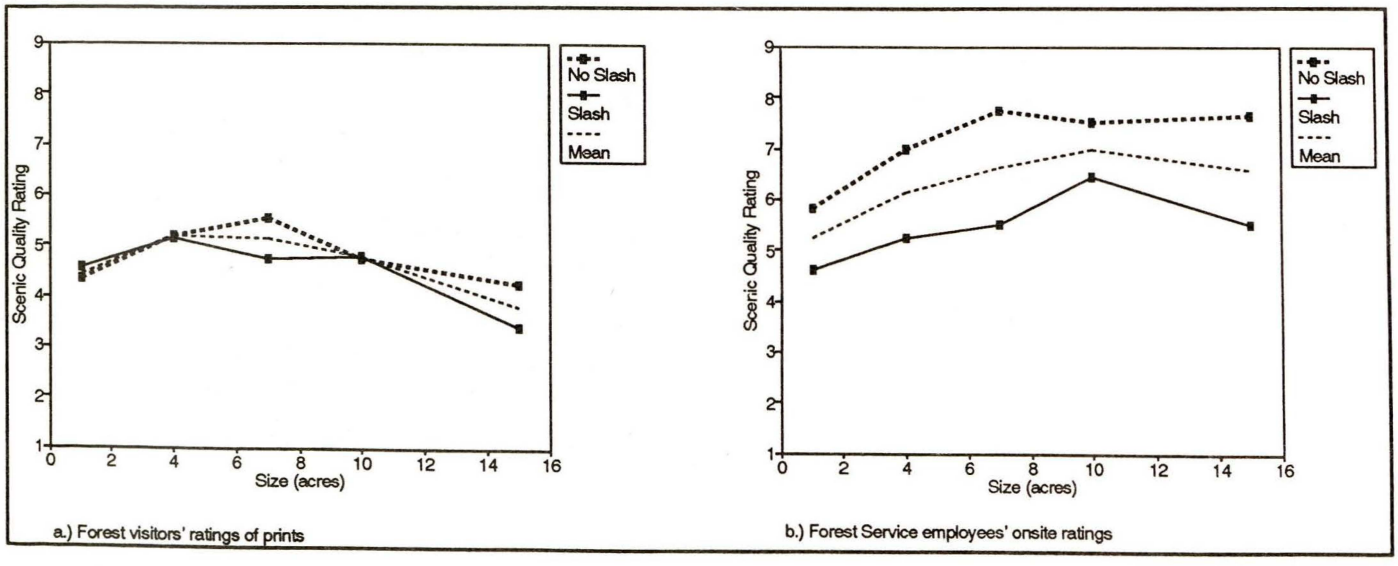

Figure 2.—*1988 ratings of newly harvested clearcuts, by rater groups.*

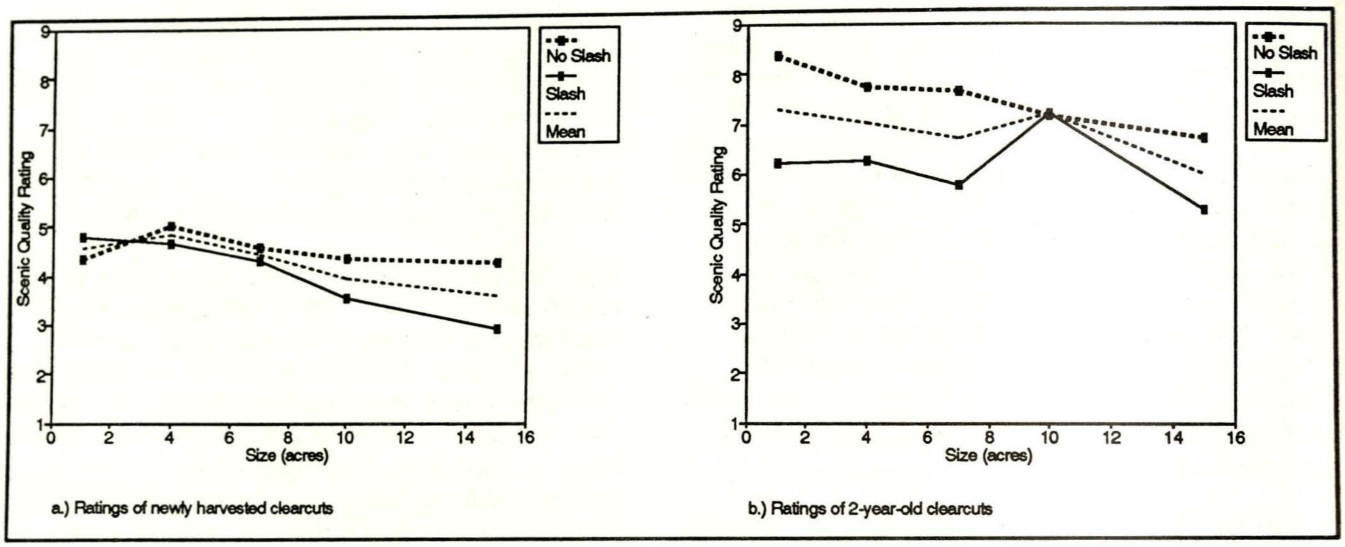

Figure 3.—*1990 ratings of photos of clearcuts, newly harvested versus 2 years after harvest.*

Table 2.—*ANOVA of Forest Service employees' and public's ratings made in 1990 of newly harvested and 2-year-old clearcuts*

Source	Degrees of freedom	F	P
Slash	1/36	26.039	0.000 *
Size	4/144	12.222	.000 *
Time since harvest	1/36	47.499	.000 *
Slash X Size	4/144	1.777	.137
Slash X Time	1/36	4.075	.051 (*)
Size X Time	4/144	3.402	.011 *
Slash X Size X Time	4/144	10.834	.000 *
Rater group	1/36	.261	.613
Slash X Group	1/36	.484	.491
Size X Group	4/144	2.448	.049 *
Group X Time	1/36	.004	.950
Slash X Size X Group	4/144	.762	.551
Slash X Group X Time	1/36	6.963	.012 *
Size X Group X Time	4/144	.729	.574
Slash X Size X Group X Time	4/144	1.151	.335

* $p < 0.05$
(*) $p < 0.10$

0.01 level. Overall, smaller clearcuts were preferred to the larger ones, and sites without slash were preferred to sites with slash. Photos of the sites 2 years after harvest were liked much better than the photos taken the year of the harvest.

Several significant interactions involving size, slash, and time since harvest occur in the ANOVA in table 2, indicating that these effects are related in a complex way. Overall, slash appears to have a greater effect 2 years after harvest than it does in the year of harvest. In addition, the 1-acre plot with no slash and the 10-acre plot with slash showed unusually large increases in scenic quality after 2 years, when compared to the other clearcuts.

Finally, in table 2 there are two significant interactions of time since harvest, slash, and size with rater group, indicating that these effects differed in a complex way between the Forest Service and the public raters. Figure 4 displays the effects graphically. It appears that the Forest Service groups were more sensitive to the size of the clearcuts than were the public groups. Also, for the public groups, slash had a substantially smaller effect in the year of the harvest than 2 years after the harvest; but for the Forest Service raters, slash had a substantial effect at both time periods.

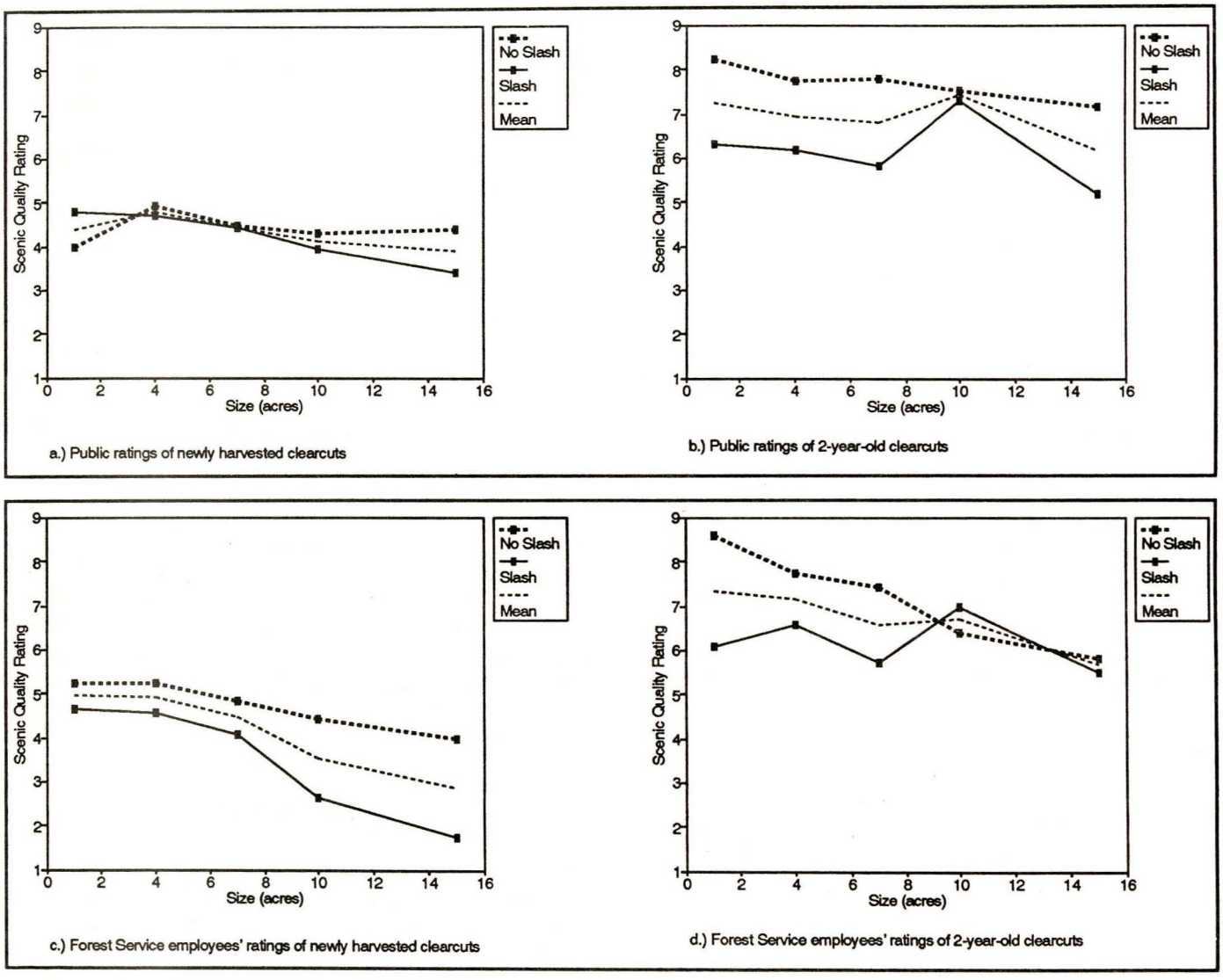
Scenic Quality Rating
Size (acres)
No Slash
Slash
Mean
a.) Public ratings of newly harvested clearcuts
b.) Public ratings of 2-year-old clearcuts
c.) Forest Service employees' ratings of newly harvested clearcuts
d.) Forest Service employees' ratings of 2-year-old clearcuts

Figure 4.—*1990 ratings of photos of clearcuts, newly harvested versus 2 years after harvest, by rater groups.*

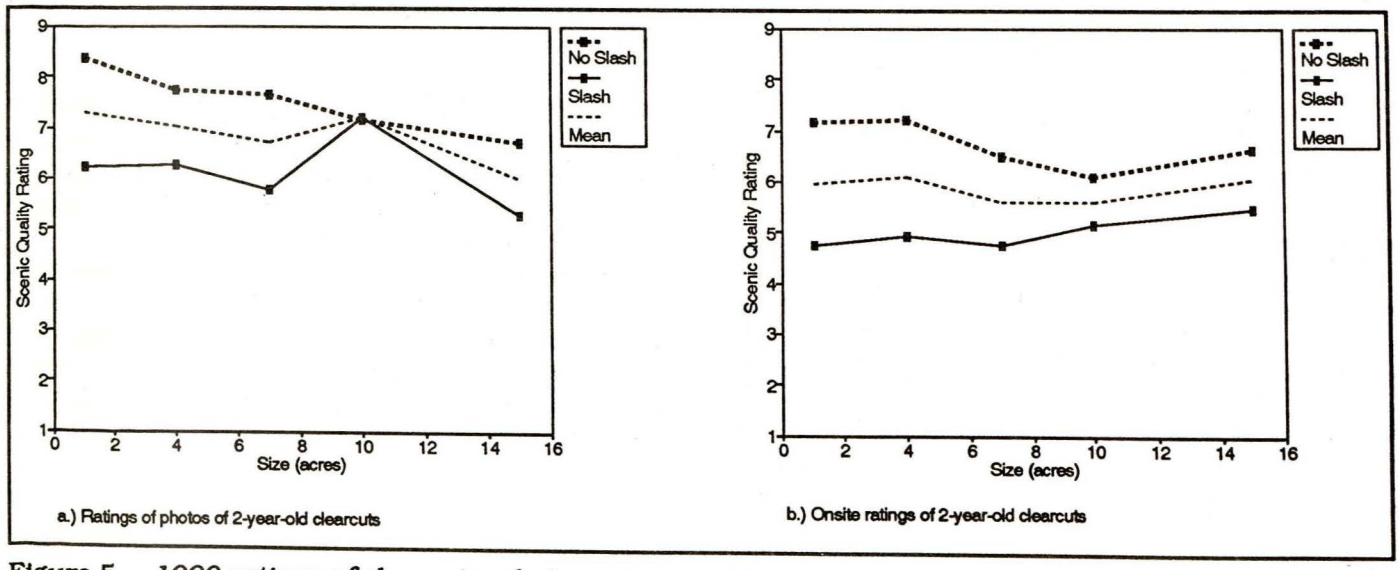

Figure 5.—*1990 ratings of clearcuts, photos versus onsite.*

To determine whether people's response to the views in the photographs were the same as the responses to the views seen onsite, a second ANOVA was run on the 1990 ratings with size, slash, rater group, and presentation medium as independent variables (table 3). This analysis included only the scenes of the clearcuts 2 years after harvest. Main effects for slash, size, and presentation medium were significant. The clearcuts viewed in photos were, on average, rated higher than the clearcuts viewed onsite (fig. 5). As in the earlier analyses, slash had a negative effect on scenic quality. Size also had a significant effect, with smaller clearcuts generally preferred over the larger ones. The exception to this size effect, indicated by the significant slash-by-size interaction, was the 10-acre plot with slash, which in photos was preferred as much as the 10-acre plot without slash, and more than any of the other plots with slash. A significant size-by-medium interaction indicates that raters onsite were less likely to discriminate between the large and the small clearcuts. A significant slash-by-group interaction indicates that the public raters were more sensitive to the presence of slash than were the Forest Service raters (fig. 6).

Table 3.—*ANOVA of Forest Service employees' and public's ratings made in 1990 of 2-year-old clearcuts viewed onsite and in prints*

Source	Degrees of freedom	F	P
Slash	1/63	53.702	0.000 *
Size	4/252	3.810	.005 *
Presentation medium	1/63	7.145	.010 *
Slash X Size	4/252	9.408	.000 *
Slash X Medium	1/63	.696	.407
Size X Medium	4/252	4.490	.002 *
Slash X Size X Medium	4/252	.936	.444
Rater group	1/63	.006	.939
Slash X Group	1/63	5.163	.026 *
Size X Group	4/252	.625	.645
Group X Medium	1/63	.324	.571
Slash X Size X Group	4/252	1.445	.220
Slash X Group X Medium	1/63	.925	.340
Size X Group X Medium	4/252	1.201	.311
Slash X Size X Group X Medium	4/252	1.665	.159

* $p < 0.05$

One additional analysis was run, comparing the 1988 public ratings of prints of the clearcuts with the ratings of the same prints made by different public raters in 1990 (table 4). This analysis showed no significant differences between the ratings made in the two different years. This suggests that the difference in the photo format (i.e., the cropping of the foreground features in the 1990 prints) did not affect preferences.

Table 4.—*ANOVA of public's ratings of photos of newly harvested clearcuts*

Source	Degrees of freedom	F	P
Slash	1/113	1.171	0.282
Size	4/452	8.480	.000 *
Year of ratings	1/113	.643	.424
Slash X Size	4/452	3.661	.006 *
Slash X Year	1/113	.103	.749
Size X Year	4/452	1.325	.260
Slash X Size X Year	4/452	.934	.444

* $p < 0.05$

DISCUSSION

The analyses reveal a complex pattern of effects of slash, size, presentation medium, time since harvest, and rater group on perceived scenic quality of the experimental clearcuts. The numerous effects and interactions are not always consistent and are difficult to interpret. The major results are summarized below, with some possible explanations for why they occurred and some implications for managing this type of forest.

The effect of size is statistically significant in all the analyses, but the nature of the effect is not consistent across all the analyses. In general, the 1- and 4-acre plots were most preferred and the 15-acre plots were preferred least. The results suggest that as a rule forest openings near roads should be kept small, e.g. 5 acres or less. However, size of clearcut appears to interact with other factors in a complex way, and it is difficult to identify an overall optimum size for clearcuts in this size range.

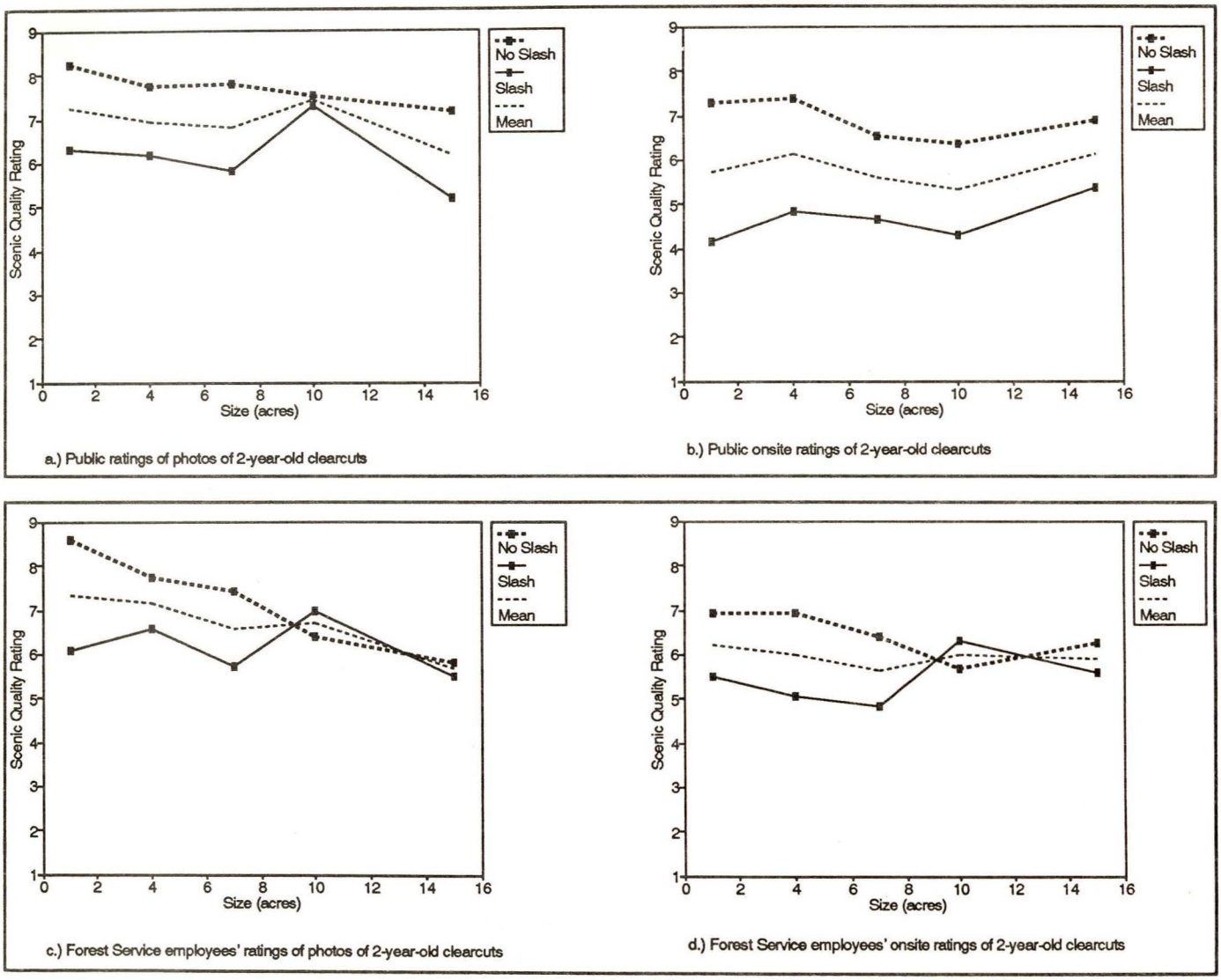
Scenic Quality Rating
Size (acres)
No Slash
Slash
Mean
a.) Public ratings of photos of 2-year-old clearcuts
b.) Public onsite ratings of 2-year-old clearcuts
c.) Forest Service employees' ratings of photos of 2-year-old clearcuts
d.) Forest Service employees' onsite ratings of 2-year-old clearcuts

Figure 6.—*1990 ratings of clearcuts, photos versus onsite, by rater groups.*

Slash had a consistently negative effect on scenic quality across all the analyses. The strength of this effect varied in a complex way, however, depending on the size of the plots and the time since harvest. Slash had less effect on the 10-acre plot than on the other plots. This was especially true 2 years after harvest, when the 10-acre plots with and without slash were rated essentially equal. The 10-acre slash plot in year 2 was rated much higher than any of the other plots with slash. This may be because a row of low shrubs had grown up at the opening to the cut area by the end of the second year in the 10-acre plot. These shrubs obscured the view of the slash lying on the ground behind. In the other plots, slash was not obscured to the same extent. This suggests that foreground features may play a large role in increasing or decreasing the attractiveness of a roadside clearing, and that cleaning up slash, avoiding ground disturbance, and leaving some vegetation close to the roadside may significantly improve the view.

The medium of presentation (photos versus onsite) also influenced ratings. Two years after harvest, ratings of photos of the plots were higher than ratings made onsite. This could indicate that the photo format made the clearcuts look better than they actually were. More likely, however, it was due to the differing context in which the judgments were made. The photos taken 2 years after harvest were shown to raters in the same book with the photos taken shortly after the harvest. So the two sets of scenes could

be compared with each other, which may have made the 2-years-after-harvest photos look especially good relative to the immediately-after-harvest photos. No such comparison was possible in the onsite evaluations.

The effect of presentation medium varied across the differently sized plots. Relative to the other plots, the 10-acre plots were rated high in photos and low onsite. As explained above, this may be due to a row of shrubs that obscured the slash lying on the ground in one of the plots. The onsite raters may have been able to move around enough to see more of what lay behind the row of shrubs. The 15-acre plots were rated low in photos and high onsite. This may be because the wide-angle 28mm lens format made the 15-acre plots look larger in the photos than they actually appeared onsite.

Time since harvest had a strong effect. Photos taken 2 years after harvest were rated much higher than photos taken shortly after the harvest. This is probably due to the regeneration in the clearcuts and the recovery of grass and other ground cover in the foreground of the scenes. Ratings were also probably influenced by the brighter, sunnier lighting conditions in the 2-years-after-harvest photos. The effect of time since harvest was greatest for the 10-acre plots. Again, this may be a result of the row of shrubs that grew up and obscured the slash in the 10-acre plot with slash.

The pattern of responses differed somewhat between the Forest Service employees and the public raters. The effect of plot size on the public's ratings was smaller than on the Forest Service employees' ratings. It is not clear why. Perhaps foresters are more accustomed to thinking about management areas in terms of acreage and to estimating the size of plots on the ground. In any event, this result suggests that for public viewers the difference in size between plots in the 1- to 15-acre range may be relatively unimportant compared to the presence or absence of slash and the appearance of foreground elements.

Forest Service employees and the public also differed in how the effect of slash changed over time. For the Forest Service employees, slash had a large effect on ratings of the photos taken both in the year of the harvest and 2 years later. For the public, however, slash had little effect on ratings of photos taken the year of the harvest, but a large effect on photos taken 2 years later. It is not clear why.

CONCLUSION

This study is a first step toward understanding how people perceive the visual quality of conifer stands in central Michigan. Management actions have a measurable impact on the attractiveness of these forests, which are within easy driving distance of several major urban areas in the Midwest and consequently receive heavy use. Removing slash greatly improved the appearance of experimental clearcuts after harvest. Small clearcuts (1 to 4 acres) were generally preferred over larger clearcuts (10 to 15 acres), but immediate foreground features sometimes seemed to obscure the effects of slash and clearing size. There were also complex interactions between the physical attributes of the landscapes, the method of presentation of scenes for evaluation, and the types of people who evaluated the scenes. Additional studies may help to sort out the influences of these factors, as well as to extend the research to a wider range of forest types and management approaches in this region.

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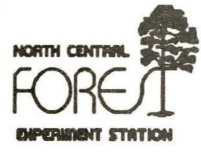
Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.



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